

BEFORE THE MEETING IN SPACE

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## BEFORE THE MEETING IN SPACE

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[Correspondent Yelena Knorre interview with Maj Gen of Aviation V.A. Shatalov: "Before the Rendezvous in Orbit"]

[Text] [Question] Vladimir Aleksandrovich, how do you, a person who has been in space three times and who carried out the first docking of manned spacecraft in history, explain the acute interest in the forthcoming Soyuz-Apollo flight? After all, at first glance, in the technical respect everything has already been tested and "performed" more than once by each country independently--manned space craft, docking in orbit....

[Answer] I am convinced that the Apollo-Soyuz experiment can rightly be considered a qualitatively new stage in the conquest of space, and not only technically but also in the political sense. Incidentally, it is perhaps impossible to separate these two aspects from each other generally in such a complex matter as the penetration of a completely new milieu of mankind's habitat.

The leading space powers--the Soviet Union and the United States--really have gained great experience in circumterrestrial flights, including manned flights. Since our first docking between the Soyuz-4 and Soyuz-5 in 1969 there have been repeated linkups in space between craft and orbital stations. Most valuable material has been obtained during the work of Soviet Salyut orbital stations and the U.S. Skylab. Nonetheless, these are only the very first steps, the initial stage of mastering circumterrestrial space, and yet we dream of flights to Mars and Venus, to new worlds, to more distant planets--we want to blaze reliable paths in outer space.

We can move onto the next stage only, putting it simply, when we have completely insured the safety of long-distance flights. For this, is it necessary to develop and master universal facilities for making an approach, and also docking devices.

You can judge for yourselves how all this is inseparably linked to the humane goals of mutual assistance in space, the tasks of creating international orbital stations, and the possibility of replacing the crews of such stations.

The Apollo-Soyuz program provides for the joint development by the two most "developed" countries in terms of space research of a reliable docking device and its testing in space, and also the modification of two craft, having different systems, for common work as a single unit--a unified system. Joint tasks will also be carried by the crews--Soviet cosmonauts and U.S. astronauts. They, too, will comprise a unified whole: one crew with a common aim, where success depends on each person's efficient work and where the hard and complex conditions make the feeling of confidence in each other and responsibility for each other by no means a formal concept.

It needs scarcely be said how important it is to all who are not indifferent toward the successful development of cosmonautics not only to get the opportunity to make use of the best of everything in both countries' technical experience, but also to see, with one's own eyes, as the saying goes, an international community of researchers into the universe and the prototype of future space crews of earthmen jointly mastering a new habitat.

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[Question] It would be interesting for our readers to learn in more detail how this unique joint flight will take place. Could you describe a little of the program and specific tasks of the Apollo-Soyuz flight?

[Answer] You probably know that the flight has already been under preparation for 2 years on the basis of the agreement between the USSR and the United States on cooperation in research into and peaceful use of outer space, signed on 24 May 1972 in Moscow. At first it seemed to us that 2 years was an enormous amount of time and we wanted to carry out the flight as soon as possible. But during the preparations it became clear how complex the forthcoming tasks are and what a lot of strenuous work is required, so that 2 years has proved to be not all that long.

The launch is set for 15 July 1975 at 1537 Moscow time. A Soviet craft with two cosmonauts aboard will be first to go up into space. The Apollo with three astronauts aboard will set off 7.5 hours later. This time is necessary so that the Earth will have revolved in space relative to the stars, and the Kennedy Space Center on Cape Canaveral will have reached the same paths as that in which the Soyuz, launched from the Baykonur Cosmodrome, will already be orbiting in space. If the Soyuz and Apollo crafts were launched from the same space center, they would have to wait exactly 24 hours, as was the case with the launching of the Soyuz-4 and the Soyuz-5 or with the launching of the Salyut type stations and the Soyuz shuttle craft.

After approximately 48 hours after the launch of the Soyuz, on its 36th orbit, the two craft should find each other.

It is not easy for people on earth to imagine what the docking of two spacecraft involves. Imagine a bottomless blackness in which the unfading starter burns in contrast and somewhere far, far away there is the blue of mother earth left behind.... However trained a person may be, he nevertheless becomes almost melancholy and feels himself and the craft to be a tiny grain of sand which has to find another such grain and link up with it in the infinite expanse. What precision of orbital correction of the two craft is necessary if they are traveling at a speed of 8 kmpersecond! A deviation of a fraction of a second and they lose each other.

Another problem is the docking itself. The Soyuz and the Apollo were developed in different countries when nobody even thought of joint flights. The docking devices on them are based on the "probe-and-drogue" scheme. That is, a craft equipped with a "probe" type device can link up only with a craft of its own country only if that one is equipped with a "drogue" system. This system is quite simple and reliable. However, it cannot allow a docking of two spacecraft of one country if both only have "probes". It is even less possible to have mutual aid between craft of different countries which have completely different "probe" and "doggles." Consequently, it is necessary that they should all be equipped with universal docking devices. It was to this end that Soviet and U.S. designers, in the preparations for the linkup, developed a fundamentally new docking assembly which is universal and is suitable for the Soyuz and the Apollo.

Models of the assembly have been tested in Houston on a dynamic stand but these were models scaled down by a factor of 2.5. The docking assembly, which looks like a flower with three extended petals (they interlock like fingers on hands), was first tested in space during the flight of the Soyuz-16. To work it and test it on the Soyuz-16, a special ring was used, which was pulled on by special hooks. The ring simulated the dock of the Apollo craft. During the flight Cosmonauts A.V. Filipchenko and N.M. Rukavishnikov switched various components of the docking device on and off, removed the ring from the craft, and drew it back on again.

The Soyuz and Apollo will fly linked up for 48 hours. During this time it is planned to carry out four crew transfers from craft to crafts. One of the main difficulties here is the difference in atmospheres in the two craft. The cosmonauts breathe air (more precisely, a mixture of nitrogen and oxygen) at conventional "earth" pressure whereas the astronauts breathe oxygen at a lower pressure. This choice, made by each country many years ago, is today already a tribute to custom. An oxygen system is more compact but not as safe as a system using air. Many U.S. specialists now acknowledge the advantages of an air atmosphere; in particular, it is envisaged in the next U.S. manned space shuttle craft. However, it was inexpedient to modify the Apollo to an air system in such a short time and therefore it was resolved to create a special transfer module--a kind of air lock. It is a cylindrical chamber 3 meters long and 1.5 meters in diameter, which will be carried up by the Apollo. Two people can fit in it at the same time. During transfers the joint crew can create in the air chamber the same atmosphere as that in the ship to which it is transferring. In order to reduce acclimatization time, the pressure in the Soyuz craft will be reduced approximately 30 percent before the docking. These systems were also tried and tested during the Soyuz-16 flight. The crew reduced the pressure in the landing capsule and the orbital compartment from 760 to 520 on the mercury column and at the same time increased the oxygen content. The cosmonauts felt well during this. During the landing the craft was again "inflated" to normal pressure.

In addition to the technical program, a scientific work program is also provided for during the linkup. It includes both independent and joint experiments. Even before the meetings in 1973, Soviet and U.S. specialists planned five joint experiments.

The first is "ultraviolet absorption." It was proposed by U.S. scientists in order to measure and ascertain the concentration of atomic oxygen and nitrogen in outer space. The methods of the experiment are being worked out in the Institute of Space Research in Moscow and the apparatus for it in the United States.

The second experiment has been nicknamed "Universal Furnace." It was also proposed by U.S. scientists and aims to study the influence of weightlessness on the fusion and crystallization processes of various materials. The composition of the samples has been proposed by Soviet specialists.

Two other experiments are biological. I have in mind the experiment "zone-forming mushrooms" proposed by Soviet scientists and the "microbe exchange" jointly proposed by Soviet and U.S. specialists.

Zone-forming mushrooms are a variety of mold which multiplies without any special nutritive environment with the aid of ring-like spores. The mushroom produces one ring every 24 hours, the way trees form annual rings in the trunks. A study of them will throw light on the secrets of the biological rhythms determining life processes.

The microbe research will enable scientists to ascertain the laws of natural exchange of microorganisms during human intercourse, and their results will make it possible to work out recommendations for preventing cosmonauts falling ill on long space flights.

And, finally, an interesting experiment proposed by scientists of the USSR Academy of Sciences Institute of Earth Magnetism, Ionosphere, and Radiowave Propagation. It is called "artificial solar eclipse."

When after 48 hours of joint work the cosmonauts return to their craft, undock (according to the plan this should take place on the 68th orbit) and the craft comes out of the earth's shadow, the Apollo will assume the role of the moon in a natural solar eclipse and the Soyuz the role of the earth. Put simply, the Apollo will cast a shadow on the porthole of the Soyuz craft's orbital section, where a photographic camera will be fitted. It is tempting to take advantage of such a unique opportunity to make a photographic study of the solar corona during a phenomenon which is rare in nature. Scientists are looking forward to the results of this experiment.

In all, the Soyuz will spend 6 days--142 hours--in orbit. Although the launch and flight schedule of both craft have already been calculated to a fraction of a second, specialists nevertheless reserve the right to have a "launch margin," that is, a deviation from the schedule in case of need.

[Question] How do you rate the degree of readiness attained today? What is still planned to be done in the final period before the launch?

[Answer] Briefly, I would say that the Soyuz spacecraft is ready for the rendezvous with the Apollo. This has been confirmed by the successful flight of the Soyuz-16, with whose program the crew--commander A.V. Filipchenko and Flight Engineer N.N. Rukavishnikov (and this is the first backup crew for the linkup)--coped splendidly.

A gigantic amount of work has been done by the two countries both jointly and separately. I have already described the most important features but there have also been dozens of others. Not everything always went as smoothly as desired--after all, space is a serious and perfidious thing, capable of springing surprises. However, on the whole we are pleased with the results obtained.

As is known, Soviet designers, engineers and cosmonauts have worked in the L. Johnson Manned Space Flight Center in Houston, and American ones here in the Yu. A. Gagarin Cosmonaut Training Center in Zvezdnyy Gorodok near Moscow. It has turned out that, in addition to familiarizing ourselves with each other's technical innovations, it is necessary to coordinate further dozens of questions. For example, flight documentation, terminology, details of carrying out experiments, consistency of operations during docking in space, training methods on the ground....

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The crews have familiarized themselves with the facilities of the Soyuz and Apollo craft and the centers' equipment, have carried out laboratory and study class tests of the work of radio systems and have studied television and cine- and still-photographic apparatus. In flight, each cosmonaut and astronaut must primarily have irreproachable knowledge of his craft. In addition, he should have excellent knowledge of the systems of both spacecraft participating in the flight. This is essential so that each crew member feels absolutely confident and is a completely equal participant in the work of the unified system which the two docked craft will create. Space is space and nobody can bet that no unforeseen situation will arise during the flight. Therefore, each should be able to quickly seek out the cause and also to eliminate the fault.

We have also coordinated with U.S. specialists the program of preflight and post-flight medical observation. Since we have agreed to provide each other with all data of medical observations on the crews of the Soyuzes and the Apollos, the need has arisen to make these data comparable. Unified methods of observations have been worked out for this, a kind of "docking" of space medicine specialists.

It is not only cosmonauts and astronauts, specialists and training leaders who are preparing for the forthcoming flight but also the chefs. The astronauts will appreciate the particular features of Russian cuisine during the flight when they are the guests of their Soviet colleagues, and American products will be tried by the cosmonauts during the visit to the Apollo. Each crew will take with it packaged dinners and lunches for their colleagues. Incidentally, this is not such an unimportant problem as it may seem at first glance. During the training sessions the cosmonauts and astronauts tasted each other's food so as to get accustomed to it and not have any surprises. The astronauts found they liked kharcho and Moscow borshch, ham, mutton and chicken with prunes. American dishes are generally similar to ours, only more spicy and sweet. The space ration was chosen with account taken of individual tastes--not everyone, for example, likes corn soup or Russian cheese. As far as drinks are concerned, they are almost identical for both crews--first of all water, well cooled and silver-pure [serebrennaya] to keep it fresh longer, and then juices, coffee....

In the time left until 15 July it is planned to carry out training sessions for the crews and joint preparation of the personnel of the mission--control centers in the USSR and the United States. The Soviet cosmonauts will again go to Houston in February and familiarize themselves with the space center at Cape Canaveral and the Apollo craft in the period of preparing for its launch. The U.S. astronauts will also come to us to Zvezdnyy Gorodok. They will be given an opportunity to visit Baykonur, where preparations will be underway for the launching of the Soyuz. It is planned to carry out joint tests of the communications systems in May 1975.

As far as the sphere closest to me--crew training--is concerned, I must say that all four Soviet crews are ready for the flight and in general their degree of readiness is identical.

[Question] Since you have already mentioned it, could you explain why the Soviet side is training four crews and the American side only two?

[Answer] Indeed we are preparing two Soyuz craft at the same time. You already know that the Soyuz will be launched first. It will be in space, and during this time, simultaneously with the Apollo, another Soyuz--the reserve--will be prepared for launching. This is necessary so that no accident can prevent the carrying out of an important space experiment. It is customary for two crews to prepare for each craft--the primary crew and a backing crew. The reserve Soyuz, like the main one, will be equipped with everything necessary for approach, mooring and docking. If the Apollo is delayed for some reason for more than 5 or 6 days, when we shall no longer be able to wait for it in orbit, it will be possible to launch the second Soyuz. Another two crews will be ready for it on the ground.

In addition, we hope that the linkup will be the first but not the last joint experiment and that the specially trained cosmonauts will not be left without work.

[Question] Vladimir Aleksandrovich, what can you, the crew-training chief, say about the specific features of the joint training of cosmonauts and astronauts? Is our training system very different from the American system? Have you come across any unexpected problems, say, of a psychological nature?

[Answer] It must be said that there have not been any special problems. Much that we saw in Houston proved to be familiar to a certain extent. In particular, the cosmonauts and astronauts have almost completely unanimous views on questions of crew training. The programs are amazingly similar not only in volume, not only in facilities used for training, but even in the methods of independent training where the same flight stages are "played out" as are here. And this is not a chance coincidence. Simply, our tasks are very similar and the demands made of the space crews are approximately the same, and this dictates similar methods and choice of facilities, just as, say, speed requirements give rise to a similar form of automobile or aircraft....

There is, of course, the problem of the language barrier. The cosmonauts have had to learn English thoroughly, and the astronauts have been at their Russian textbooks for 4-6 hours a day. To help our American colleagues, all the necessary technical materials on the Soyuz had been prepared in English. The ring-binder of technical flight documentation is in parallel text--one page in Russian, the other in English. During the training sessions the crews found that the stock of words they had was enough to understand each other; by the time of the flight we expect that both the cosmonauts and the astronauts will have completely mastered a much bigger vocabulary. It has been decided, for example, that during the flight the Soviet crew will speak in English and the American in Russian. It is easier this way, because when a person is not speaking his native language he pronounces the words more clearly and slowly and is more easily understood.

Well, and as regards psychological problems, everything has gone well here from the very beginning, in my opinion. In addition to sincere friendship based on the affinity of the same job, which everyone is trying to do as well as possible, and in addition to the excellent, purely businesslike relations, there are also personal relations and between families. I, for example, have good mutual relations based on profound personal liking with astronaut Donald Slayton, who is in charge of training the astronauts, and with the charming Thomas Stafford, who has been in space three times and is commander of the Apollo primary crew....

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[Question] I do not know to what extent I have understood you correctly, but I think that both at the beginning of our conversation and in other of your conversations, you, Vladimir Aleksandrovich, have expressed the idea that the future of cosmonautics lies with long-term orbital stations. Where do you see their advantage?

[Answer] This is not only my opinion. All efforts of Soviet cosmonautics are concentrated in this specific direction. Long-term orbital stations, of which docked craft of the Soyuz-Salyut tandem or the American Skylab may serve as the prototype, will enable specialists of different countries and different branches of science to organize systematic observations in space. This is an invaluable experimental base both for scientists and for engineers, about which it is as yet impossible even to dream under earth conditions. Any amount of deep vacuum--there it is, weightlessness--you can have it for any time you like; superlow temperatures--in unlimited amounts and gratis. It is possible to assemble devices and apparatuses of gigantic size in space under weightless conditions. For example, at the moment the largest diameter of telescope mirror on the ground is 6 meters. Any bigger and it bends under its own weight. It is possible to set up an optical telescope with a mirror of virtually any diameter on an orbital station. Scientists are seriously studying the possibility of creating atomic power stations in space, organizing the extraction of valuable raw materials on the planets and the production of many articles which are impossible to create under gravitational conditions. As yet this sounds fantastic, but all of cosmonautics in general is fantastic. After all it is truly a leap into a fundamentally new milieu. And the paths to other worlds? They, too, lie via orbital stations, which are kinds of space ports. I believe we shall still witness the creation of orbital stations for various purposes, of which Tsiolkovskiy dreamed, calling them "man's settlements in the ether," and which will become an organic part of circumterrestrial space. I believe that in the near future mankind will find a solution to the complex but nonetheless feasible technical problem of creating a space apparatus which can be used many times, a kind of "space ferry" which will carry out shuttle trips from the earth to the orbital stations and back.

[Question] There is scarcely a person today who does not understand that scientific progress and ultimately the future of mankind greatly depend on the successful mastery of outer space. But then the lavishness of space is actually appreciable even now, in our day?

[Answer] Yes, the new branch of knowledge--space geography--is already producing a marked saving. I shall not list such widely known things as satellite communications facilities--television, telephone, space meteorology, the development and protection of water resources, and soil conservation. It is quite sufficient to cite only what has been dubbed "space technology" or "production under space conditions" [kosmizatsiya proizvodstva]. Remember the welding in Soyuz-6, the electrophoresis on the Apollos, and the smelting on Skylab. In principle, the unique conditions of weightlessness make it possible even now to obtain particularly pure vaccines, ideally round molds, and homogeneous mixtures.

According to the forecasts, "space technology" will produce such a saving even within a few years that all space expenditures will have been recouped.

Nor should cosmonautics' so-called "spinoff" be forgotten. It is this which today greatly determines the industrial development level of a particular country and the correspondence between produced output and the "world standard."

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Whereas at the beginning of the conquest of space there were only two space powers in the world--the USSR and the United States--many states are now carrying out their national programs and participating in joint research. An important feature of modern cosmonautics is its graphically expressed international nature. Manned or unmanned space apparatuses in space orbit can conduct research and serve the whole planet. All countries need their results. People have finally begun to understand that they have one common home, and not such a big one--the planet earth--and that it is necessary to learn to live in such a way as to preserve it for our children and grandchildren....

[NOVYE VREMYA postscript] More than half a century ago Herbert Wells, after a meeting with V.I. Lenin, noted down his remarks on the novel "The Time Machine": "All human notions are created within the scale of our planet; they are based on the supposition that technical potential will never develop beyond the earth's limits. But if we manage to establish interplanetary links, we shall have to review all our philosophical, social and moral notions."

The space age, which began with the launching of the first earth satellite, has filled these prophetic words with specific content. Research into space has not only enriched the most diverse branches of human activity, but also left a specific imprint on human consciousness itself. It is not accidental that many scientists in different countries are engaged in quests for other reasoning civilizations and other habitable worlds. And if our hopes to contact intelligent life in outer space are some day fated to come true, we will for the most part be indebted to the realization of the Apollo-Soyuz project, which apart from anything else, will be yet another necessary landmark in man's age-old striving for distant worlds....

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